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EVALUATION OF A. D. LITTLE, INC. MODEL 60 HELIUM REPURIFIER.(U)
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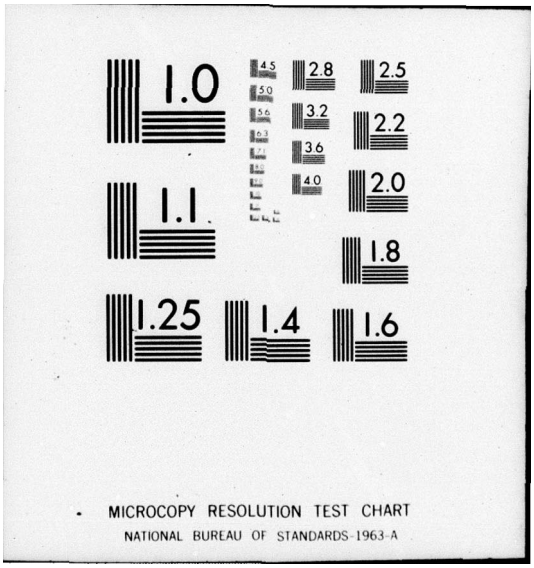
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NAVY EXPERIMENTAL DIVING UNIT

NAVY EXPERIMENTAL DIVING UNIT
WASHINGTON NAVY YARD
WASHINGTON, D.C. 20390

EVALUATION OF A. D. LITTLE, INC. MODEL 60 HELIUM REPURIFIER

LETTER REPORT 1-70

by

STEPHEN D. REIMERS

Submitted

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NAVY EXPERIMENTAL DIVING UNIT
WASHINGTON NAVY YARD
WASHINGTON, D.C. 20390

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3960
Ser: 617
6 AUG 1970

From: Officer in Charge, Navy Experimental Diving Unit
To: Commander, Naval Ship Systems Command (Code 00C)

Subj: Letter Report 1-70, Evaluation of A. D. Little, Inc. Model 60 Helium Repurifier

Encl: (1) Schematic: Model 60 Helium Repurification System
(2) Operating Cycle Model 60 Helium Repurifier as used at the Naval Medical Research Institute

1. In 1966 under contract N600-66210, the Navy Experimental Diving Unit purchased a helium repurification system for use at EDU and for evaluation for shipboard use. The system purchased is the Model 60 Helium Repurifier (serial number 31045-1-1) manufactured by 500 Incorporated, a subsidiary of Arthur D. Little, Inc. Purification of the impure helium is accomplished by cooling the impure gas until the bulk of the impurities freeze out or liquefy and then cryogenically adsorbing the remainder in a silica gel bed. (See enclosure (1)). Liquid nitrogen is used as the cold source for the repurification process, and the system has a design throughput capacity of 12 standard cubic feet per minute (scfm). The system has a total throughput capacity of 6000 standard cubic feet (scf) before the silica gel bed must be regenerated by heating it to 200-250 degrees F.

2. After a period of unsatisfactory operation, the unit was returned to the manufacturer in April 1968 for modification and repair. After its return to EDU the unit was used for a short time, and then its use terminated completely. Two apparent reasons have suggested themselves as the causes for the limited use of the system. First, the system was reported by everyone associated with it to be uneconomical since the reclamation costs were estimated at 4 to 5 cents per scf and EDU could buy new helium at 3 cents per scf. Secondly, the system as set up at EDU employs a 1000 scf gas bag located between the roof of the building and a false overhead located in the shipfitter's shop. The bag has controls which are supposed to empty it automatically whenever it becomes fully inflated. However, they tend to fail; and when they do, the resulting over inflation of the gas bag collapses the false overhead in the shipfitter's shop. This happened twice in 1968 and after the second time, use of the system was discontinued.

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3. In November 1969 another attempt was made to gain experience with the system. Preliminary indications were that the system was, as previously claimed, uneconomical to operate at EDU. After a short period of operation the controls on the gas bag failed a third time, collapsing the overhead in the shipfitter's shop and rupturing a sprinkler line as well. At that point it was decided to examine the performance of an identical system installed at the Naval Medical Research Institute (NMRI) before proceeding further.

4. With the assistance of Mr. Walter E. Bent of NMRI, the performance of the NMRI unit was examined and the following information was obtained:

a. NMRI has found that an operating cycle as presented in enclosure (2) gives the most satisfactory operation. The two-day cycle is required for economical operation due to the following reasons:

(1) The silica gel bed on their unit requires two complete regeneration cycles to become fully regenerated.

(2) For reasons of economy it is necessary to wait 8 to 12 hours after regeneration before beginning the cool down cycle. This allows the system to cool down to room temperature on its own. If this were not done, the heat remaining in the system after the 250° regeneration cycle would have to be absorbed by the liquid nitrogen coolant, thus increasing the system operating cost due to greatly increased nitrogen consumption.

b. Operation in accordance with enclosure (2) gives NMRI a maximum average repurification capacity of 3000 scf per day. In practice NMRI plans on achieving 2500 scf per day.

c. The automatic liquid air dump on the NMRI system has never worked properly despite repeated attempts by the manufacturer to repair it. Consequently, the dump must be operated manually using a stopwatch.

d. NMRI estimates its repurification costs to be $60 for labor (1 1/4 man days) and $85 for liquid nitrogen per average batch of 5000 scf. This works out to be 2.9 cents per scf repurified.

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e. NMRI must pay nearly 10 cents per scf for the helium it buys due to the small quantities (30,000 scf) that they can take at any one time. NMRI, however, can buy liquid nitrogen at bulk rates through a blanket purchase contract held by the Bethesda Naval Hospital.

5. EDU repurification requirements may run as high as 30,000 scf per day during some deep saturation dives. Also due to the quantities involved EDU can buy helium at the present time for about 4 cents per scf whereas its liquid nitrogen costs per unit volume are about two times those of NMRI ($170 per 5000 scf helium repurified).

6. After examining the information given above, the system was determined to be:

a. Inadequate to meet EDU's repurification requirements.

b. Uneconomical for EDU to operate even though for NMRI use of an identical system results in considerable dollar savings.

c. Unsuitable for eventual use with shipboard deep dive systems due to its low average throughput and its requirement for liquid nitrogen.

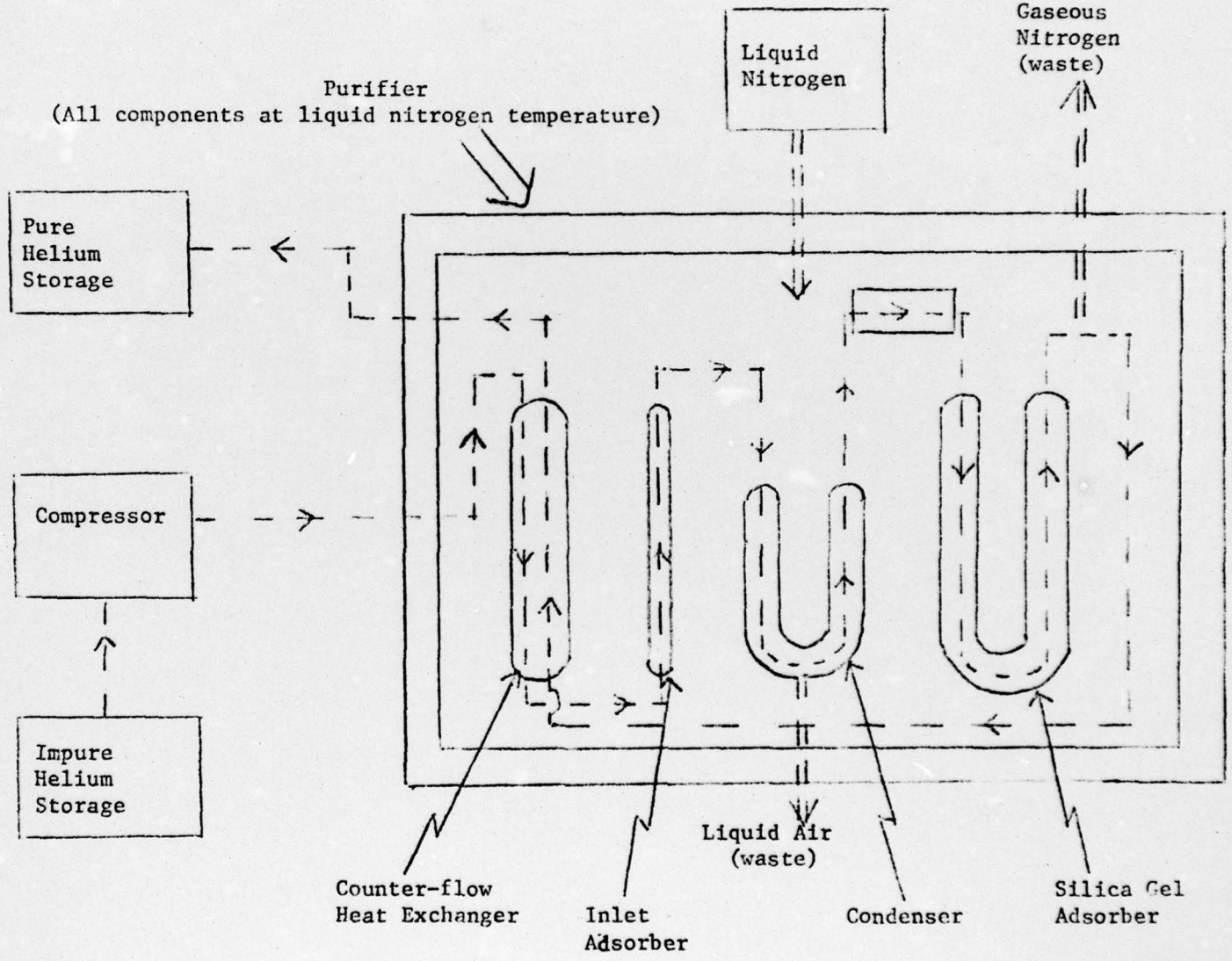
7. Contract N004-70-C-5566 has been let to buy a larger system from Air Reduction Company. The Air Reduction system will utilize a sterling cycle refrigerator as the cold source and will have a maximum throughput of 60 scfm with an inlet pressure of 15 psig or more and 30 scfm with an inlet supply of 0 psig. Maximum throughput between regeneration cycles will be 250,000 scf. The system is due to be delivered to EDU on or before 24 November 1970.

8. Efforts are currently underway to find an activity that can use the A. D. Little system.

J. H. BOYD, JR.

Copy to:
NMRI (ATTN: Mr. Chet Langworthy)

Enclosure (1)



SCHEMATIC: MODEL 60 HELIUM REPURIFICATION SYSTEM

OPERATING CYCLE

MODEL 60 HELIUM REPURIFIER

AS USED BY THE NAVAL MEDICAL RESEARCH INSTITUTE (NMRI)

Day #1		
	2 1/2 hours	Chill down
	8-10 hours	Run, this purifies 5000-6000 scf of gas at a throughput of 600 scfh
	1 1/2 hours	Regenerate silica gel adsorber
	overnight	Let unit cool to room temperature
Day #2		
	1 1/2 hours	Regenerate silica gel adsorber
	overnight	Let unit cool to room temperature

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13. ABSTRACT
This report covers the Navy Experimental Diving Unit's evaluation of the A. D. Little, Inc. Model 60 Helium Repurifier. The repurifier was used at NEDU for approximately two years. The repurifier was found to produce laboratory grade helium. It, however, was also found inadequate and uneconomical for NEDU's needs, and unsuitable for eventual shipboard use.

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